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Emergency Airway, Ventilation, and Cardiac Resuscitation

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Introduction

There are few true emergencies in dental practice, but apnea is one of them. Resuscitation of the apneic patient while maintaining adequate ventilation and airway is an act that every adult should be able to perform. Dill,[7] however, reflects that during the life of an average person, ". . . resuscitation (of an apneic person) is such a rare event . . ." In contrast, physicians and paramedical personnel are exposed frequently to situations in which resuscitation is needed—the dental anesthetist by his daily association with ill patients in the hospital, clinic, and office, and the paramedics** in the emergency services as well as in routine medical services within the hospital, clinics, and sanitoria.

It is urgent that the dental anesthetist whose need to carry out resuscitation is greatest be upgraded in his technical ability. A resuscitative deficiency is illustrated in a recent report of the Resuscitation Service provided by the Los Angeles City Fire and Rescue Service.[28] In twenty of seventy-seven calls answered by the rescue teams, physicians were in attendance and initiated the call. There were no successful resuscitations in this group attended initially by physicians. This is in contrast to the twenty resuscitations accomplished by the paramedical personnel of the Fire Department emergency rescue squads who had been adequately trained, retrained, and retested at frequent intervals. The need for repeated frequent retraining has been suggested by other studies.[2, 32, 42]

Rescue Breathing Procedures

If resuscitation of the failing or arrested heart is to be successful, the early initiation of ventilation is mandatory. Simpson,[40] as early as 1865, rec-

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**Paramedics as previously defined by Ziperman and associates[45] includes "dentists, veterinarians, nurses, medical technicians, etc." The use of the term paramedic has been herein extended and subdivided into two classes, emergency and hospital paramedics. The former includes firemen, ambulance drivers, lifeguards, and electrical and telephone linemen, while the latter encompasses dentists, veterinarians, nurses, inhalation therapists, x-ray and laboratory technicians, physician office personnel, and military medical corpsmen. Additional support to this concept is found in an editorial in Circulation 31:641, May 1965.

ognized oxygenation of the myocardium in his discussion of chloroform. He comments, "All existing facts, and all the latest experiments point to the conclusion that there is only one perfect stimulant to the failing heart, the stimulus of a sufficiently aerated blood, and the only mode of producing it is the excitation of respiration."† This is as true today as it was in 1865. Thus oxygenation of the blood to be ejected from the heart into the aorta is the first order of business. The first branch of the aorta, the coronary arteries, must be supplied with adequately oxygenated blood to perfuse the myocardium. Further efforts are useless if this is not done. The hypoxically arrested heart requires oxygenated blood if useful myocardial contraction is to be initiated, and to continue beating, the heart must receive adequately oxygenated blood.

Inflation of the lung several times prior to initiating closed-chest cardiac compression in the arrested apneic patient must be the first act in any resuscitation. If the carotid or femoral pulse is absent following chest inflation, closed-chest cardiac compression should be instituted without delay.

The apneic patient should be ventilated by the simplest, most expedient approach. The five steps required for the rescue breathing procedure, determined by experiment to be the most efficient method, are as follows:

1. Extend the head.
2. Clear the airway.
3. Occlude the nose (or mouth).
4. Place the mouth of the rescuer over the mouth (or nose) of the victim.
5. Blow into the mouth (or nose) of the victim until the chest rises.

†From Simpson, A. E.: Chloroform, its action and administration, Philadelphia, 1865, The Blakiston Co., p. 150

The manual method, recommended before 1958 by the American Red Cross and the National Research Council, was the back pressure-arm lift method (Holger, Nielsen method). Experimental evidence[23, 36, 38] overwhelmingly demonstrated that this method, as well as all prone methods, produces blockage of the pharynx by the tongue and soft tissues of the supraglottic region in the vast majority of subjects tested. In fifteen "volunteer subjects" tested using laymen as the rescuers, tidal volumes averaged 131 ml. (range 0 to 780 ml.). Tidal volumes were reported in twelve of these subjects to be less than the calculated respiratory dead space. An oral-pharyngeal airway increased the failure rate of this manual method, whereas tracheal intubation permitted adequate ventilation in all the "victim subjects" tested (Fig. 1). Thus manual methods in the absence of an intubated trachea are not efficient and are not recommended as the method of choice. There may be those rescuers who find the mouth-to-mouth method—discussed later—so repulsive that the manual method is chosen. This is the rescuer's choice and responsibility.

Since 1958 the recommended method of artificial respiration has been the expired air method revived by Elam and associates[10] in 1954. This method provides an open, patient upper airway, which is of first importance in any cardiopulmonary resuscitation. The thumb of the rescuer, hooked behind the mandibular incisors, lifts the mandible, and thus the upper airway soft tissues, open-

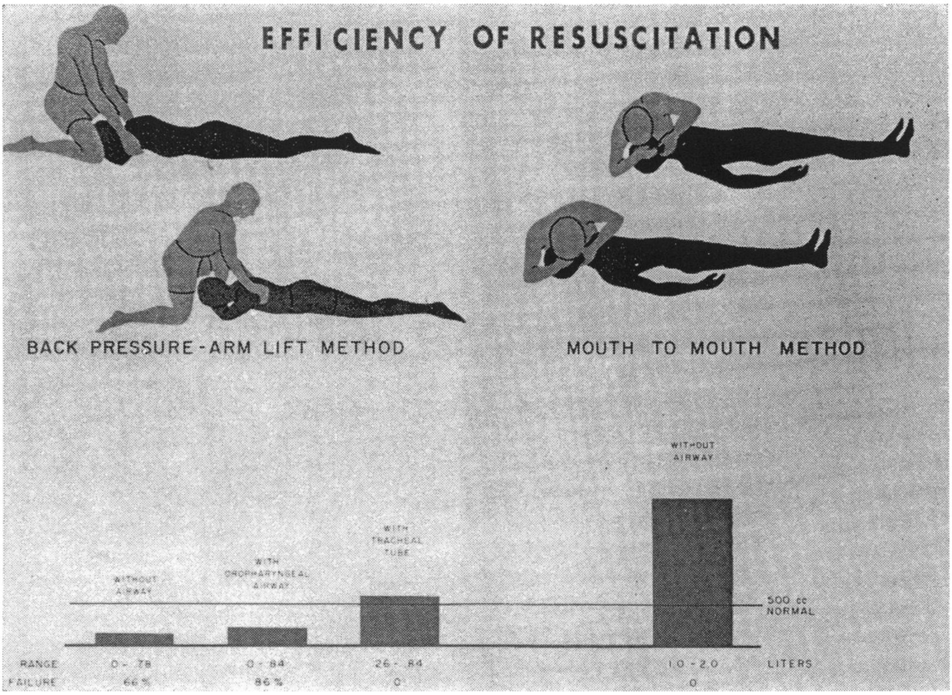

Fig. 1. Rates of success of two methods of resuscitation with and without mechanical airway support. (From Pulse of Life, Santa Monica, Calif., Pyramid Film Producers.)

ing the airway. This jaw-lift technique[17, 35] was used to investigate the effectiveness of mouth-to-mouth resuscitation by laymen.[33, 37] With this mouth-to-mouth resuscitation method, tidal volumes of 1,000 to 2,000 ml. were moved in the fifteen "volunteer victim subjects" paralyzed by muscle relaxants. Eighteen of the 165 rescuers[37] failed to produce tidal volume about 500 ml. within sixty seconds using mouth-to-mouth resuscitation in these laboratory subjects. Failure was due to poor mandible support (by the jaw-lift method), air leakage (difficulty in sealing the rescuer's mouth about his thumb), or inadequate force of blowing by the rescuer (inadequate training and experience).

In contrast, all eighty-seven resuscitators who performed the mouth-to-air-way methods were successful. Although the S-shaped airway described by Safar,[34] "Resuscitube," is always successfully used in this controlled laboratory environment with paralyzed subjects,[37] this success does not carry into the field with either this airway, the Brook airway,[3] or the Gordon airway. These airways are shown in Fig. 2. In the field these respiratory aids are dangerous. They may produce emesis in the hypoxic patient unable to protect his airway. Emesis may well be fatal in field emergency situations where mechanical suction methods and adequate laboratory facilities are absent. Fortunately, these so-called airway aids usually have been misplaced when needed or, due to trismus,[11] they cannot be introduced into the oral cavity for airway support. Also, the Lackland USAF airway,[27] the Globe Emerson army resuscitator,[12] and the Roswell Park mask[8] do not appear generally useful in the field as respiratory aids. The high failure rate in proper application of these devices by the rescuer seriously delays the beginning of adequate ventilation. The mask devices were inefficient because of the rescuer's inability to prevent excessive leakage during pressure inflation. Valuable time is lost initially finding the device and then applying it to the airway.

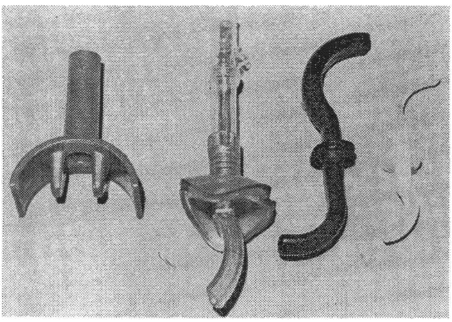

Fig. 2. Airway claimed to be helpful and useful aids in performing mouth-to-mouth rescue breathing. These are not recommended and are not needed to effect adequate ventilation. From left to right: Gordon airway, Brooks airway, Safar S-shaped adult airway, and child-sized Safar S-shaped airway. (See text for further discussion.)

Maintaining the Airway

To obviate these difficulties in obtaining patent upper airway quickly, repeatedly, and effectively (Table 1), the head-tilt method suggested by Clover[4] in 1874 cannot be surpassed. Hewett[22] in 1907 and Poe[30] in 1923 described the use of the head-tilt method, which was rediscovered in 1960-1961 by others.[9,13,14,18,29] It is now recognized as the best method.

The head-tilt method may be accomplished rapidly by hyperextension of the head on the neck. Tilting the head by applying pressure with the heel of either hand on the forehead and anterior pressure with the opposite hand on the posterior cervical area opens the airway. A bolster under the upper shoulders will produce the same effect as the upward cervical pressure. If tilting the head, as also recommended by Gordon,[16] does not provide an adequate airway, the jaw may be lifted by anterior pressure at the angle of the mandible to provide additional airway support. This requires more skill and necessitates frequent and repeated practice. The repeated practice is necessary not because it is difficult, but to refresh the rescuer's memory and sharpen his skill. Opening the upper airway may provide the only stimulus required to support unassisted respiratory exchange where respiratory obstruction previously prevailed.

Method	Seconds to attain	Minute volume	Failure (%)
Head tilt	3	8,300	0
Jaw lift	5	9,400	65
Jaw pressure	8	6,700	45

Table 1. The time needed to obtain an open airway, the minute volume achieved, and the failure rate recorded for three methods: head tilt, thumb in mandible (jaw lift), and anterior pressure at the angle of the mandible (jaw pressure)*

Inflation of the lungs should not be delayed while hoping the victim will spontaneously breathe. Mouth-to-mouth resuscitation must be started as soon as the airway is secured. Thus the next urgent step requires that the lungs be inflated. Each rescuer carries with him a ventilator—his lung and vital capacity—more than adequate to breathe for two or even three—if he

*Based on data from Gordon, A.S., Frye, C.S., Gittelson, L., Sadove, M.S., and Beattie, E.L.: Mouth-to-mouth vs. manual artificial respiration for children and adults, J.A.M.A. 167:335, 1958.

is ambitious. His dead space increases with deep breathing to 250 to 300 ml. and is filled with room air containing 20.9% oxygen. This is the first air to enter and inflate the recipient's lungs. Studies have been done in paralyzed subjects and show the recipient to be at least as well ventilated as the donor rescuer[1, 10, 19, 20] when the subject's lungs are inflated by the rescuer. The rescuer takes a deep breath, places his mouth over the subject's mouth, seals the nose, and blows. The rescuer may choose to seal the mouth and blow through the nose if the former sequence fails. The small woman or child may find the latter easier to perform when rescuing a large male. The rescuer's blowing is continued at a pressure together with sufficient air volume until the subject's chest is seen to rise. The inflation is discontinued and the rescuer listens for expired air as it is expelled from the recipient during the passive phase of respiration (expiration). This is repeated in the adult ten to twelve times per minute, fifteen to twenty times in the child, and twenty-five to thirty times per minute in the infant. Each inflation should require no longer than 1 second, permitting time between inflations to organize the rescue and to secure assistance from others at the rescue scene.

The infant is inflated by a pumping action of the tongue and cheeks of the rescuer. Both the nose and mouth of the infant are covered with the open mouth of the rescuer, and the lungs are inflated. The tidal volume of a newborn infant is only 15 to 30 ml. Care must be taken to avoid excessive volumes, overpressures, or high velocity inflation. The expanding chest remains the most reliable clinical evidence of adequate gas exchange even in the smallest infant. The small tidal volume of the infant provides only small chest expansion; therefore, careful attention must be directed to observe this sign and preclude gastric inflation and distention.

Complications

Care must be taken not to inflate the esophagus and stomach in the patient of any age. The opening pressure of the esophagus is 25 to 25 mm. Hg. This is not too important if an open airway is present or if the trachea is intubated with an endotracheal tube. The inflation air will take the more compliant route into the lungs. If the airway is occluded, however, excessive pressure will open the esophagus and inflate the stomach. In the adult, this most frequently results in regurgitation of the always present acid gastric juice and usually partially masticated food. Aspiration of acid gastric juices complicates the recovery period. In the infant, distention of hollow visci, especially during hypoxic cardiac slowing, contributes to afferent vagal stimulation and acute reflex bradycardia. Excessive and prolonged inflation pressure on the infant airway, as well as the adult airway, may cause damage to the alveolar ducts and alveoli. Many of these airway problems can be obviated by intubing the trachea. This can be done only when adequate equipment is available and the technique of intubation has been mastered by the rescuer.

Intubating the Trachea

There is no reason why every dentist as well as dental anesthestists should not be able to intubate the trachea. Every dentist, and especially the dental anesthestists should provide himself with the experience and skill to place an endotracheal tube into the trachea of the apneic patient. This ability should be as commonplace as his ability to extract a tooth, place dental nerve block, measure the blood pressure, count the pulse rate, examine the chest by ascultation, or any of the multitude of simple skills required in the everyday practice of dentistry or dental anesthesia.

Intubation of the trachea can be learned best in the fresh cadaver. The autopsy room provides this human airway and the starting point to attain this skill. The fresh cadaver most closely approximates the living subject and should be utilized at every opportunity to improve the occasional endoscopist's skill. Paramedical rescuers should also be introduced to this technique on the fresh cadaver at every opportunity. There are many patients alive and working today who were apneic and immediately intubated and ventilated by paramedical attendants. Had this procedure awaited the arrival of a physician from his office or another remote place, these patients might not have had an uneventful recovery.

Every anesthesiologist is eager to teach the willing student the art of endotracheal intubation. The anesthesiologist, an expert in this art, can provide the guiding hand and the consultation required to master the technique. Gillespie[15] has provided a detailed description. Hallowell[22] elaborately discusses the endotracheal intubation of infants and children.

Indications for tracheal intubation

In the emergency care of the airway in the apneic patient, there is no contraindication to intubation provided adequate equipment, and the intubation skills of the physician or paramedic are available or the patient does not present some rare or bizarre airway problems, precluding rapid exposure of the glottis through the mouth, this is, frozen jaw, oral tumor growth, or other unsolvable obstruction problems. To attempt to ventilate the lungs without a secured airway (intubated trachea) with or without closed-chest cardiac compression in the poorly evaluated, poorly examined emergency patient is intolerable. Nasotracheal intubation is not generally recommended in this situation as the time consumed to place the tube in the trachea blindly through the nose is too long at this critical time. However, it may be attempted since it is less hazardous than a tracheostomy under these conditions. A large-bore infusion needle (No. 18 or larger) may be inserted through the cricothyroid membrane into the trachea. One hundred percent oxygen or even air forced through the needle into the trachea will buy time so that an adequate airway may successfully be established. Every effort should then be made to place an endotracheal tube into the trachea. The needle is not an adequate airway nor can the patient be adequately ventilated. This only delays the onset of irreversible hypoxia.

Tracheal intubation equipment

Simple adequate intubation equipment suitable for an office, hospital ward, or clinic is shown in Fig. 3. The Ambu ventilator, more important in resuscitation than a blood pressure cuff, a stethoscope, or an emergency drug tray is shown in Fig. 4. Both items shown in Figs. 3 and 4 are present on each adult ward of the University of California at Los Angeles Hospital.

The infant intubation tray for emergency use (Fig. 5) is maintained on the pediatric infant ward, as well as the obstetric postnatal infant nursery.

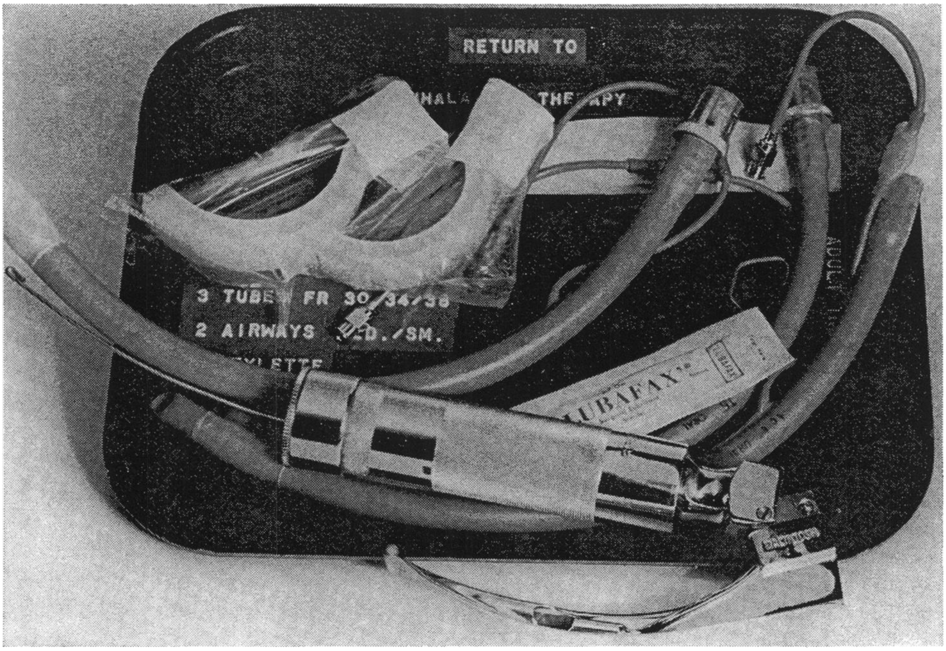

Fig. 3. Emergency adult intubation tray includes 7, 8, and 9 mm. cuffed endotracheal tubes, each fitted with a 15 mm. endotracheal connector, two oral airways, lubricant for the endotracheal tubes, stylet, and one No. 3 MacIntosh laryngoscope. The contents of this and the trays in Figs. 5 and 6 are Saran-wrapped in the tray, gas sterilized, and functionally checked weekly by the department of inhalation therapy.

These intubation trays are gas sterilized to minimize the introduction of microbiologic material into the subglottic airway. This is especially important when dealing with the infant airway and most particularly the nursery infant. An Ambu ventilator accompanies both trays, as well as the emergency pediatric intubation tray (Fig. 6). This latter tray is kept in the pediatric intensive care ward. Another similar pediatric tray, together with an adult intubation tray, is also kept in the emergency room with accompanying ventilators. These trays are checked weekly for contents and proper electrical functioning of the laryngoscope. Inhalation Therapy or Central Services maintain the function and readiness of these emergency trays. Spare units are available to replace used trays which are then reserviced following each use.

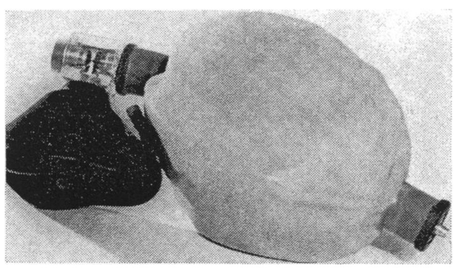

Fig. 4. The Ambu ventilator contains a reinflatable bag and a Ruben nonrebreathe valve. A suitable mask will fit on the ⅞-inch patient port, or an endotracheal tube will fit the 15 mm. inner diameter of the patient port. Positive pressure can be administered in the absence or presence of bottled oxygen. The latter may be administered through the bag via the adapter shown on the opposite end of the reinflatable bag.

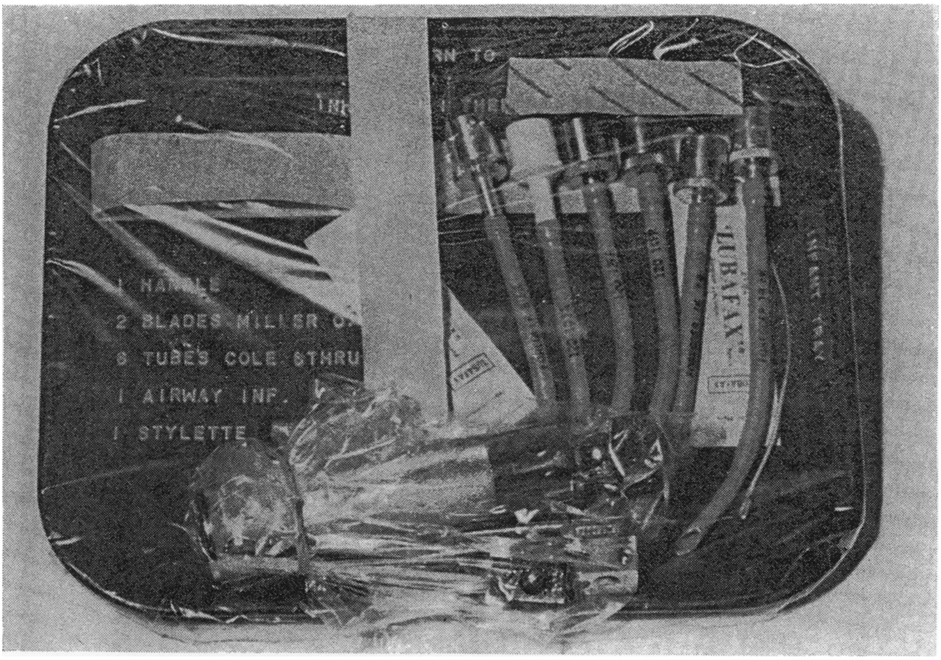

Fig. 5. Emergency infant intubation tray includes a complete set of Foregger "Cole"[5,6] endotracheal tubes for infants (Fr. 8, 10, 12, 14, 16, and 18), each fitted with a 15 mm. endotracheal connector; Miller laryngoscope blades, No. 0 and No. 1; one battery-containing handle; one infant airway; one stylet; and a surgical lubricant for lubricating the endotracheal tubes to aid smooth insertion of the tube through the larynx. This photograph shows the tray wrapped and sterilized (sterilization indicator at top of right). This tray is utilized on the pediatric infant ward and obstetric postnatal infant ward.

Massaging the heart to restore an effective beat.

Massaging the heart to restore an effective beat by closed-chest massage should be started immediately because of its simplicity and practicality. The details of this technique have been widely publicized. The patient should preferably be on a flat, hard surface. The operating table, any table of adequate size, operating room cart, the floor, etc. may be satisfactory. A bed may be too soft for effective external cardiac compression, although external compression may be started and maintained until the patient can be transferred safely to a more suitable surface. The patient in cardiac arrest is unconscious and therefore will require adequate help if he is to be moved, even to the floor.

The heel of one hand is placed on the lower half of the sternum with the second hand on top (of the other hand) (Fig. 7). Very firm pressure is applied vertically, downward toward the spine, and released about sixty times per minute. This procedure displaces the sternum toward the spine, thereby compressing the heart. About 2 to 3 cm. movement should be achieved. The force of the compression will have to be adjusted to the size of the patient. Larger patients may require the full weight of the operator in order to achieve adequate compression.

A clear airway should be assured

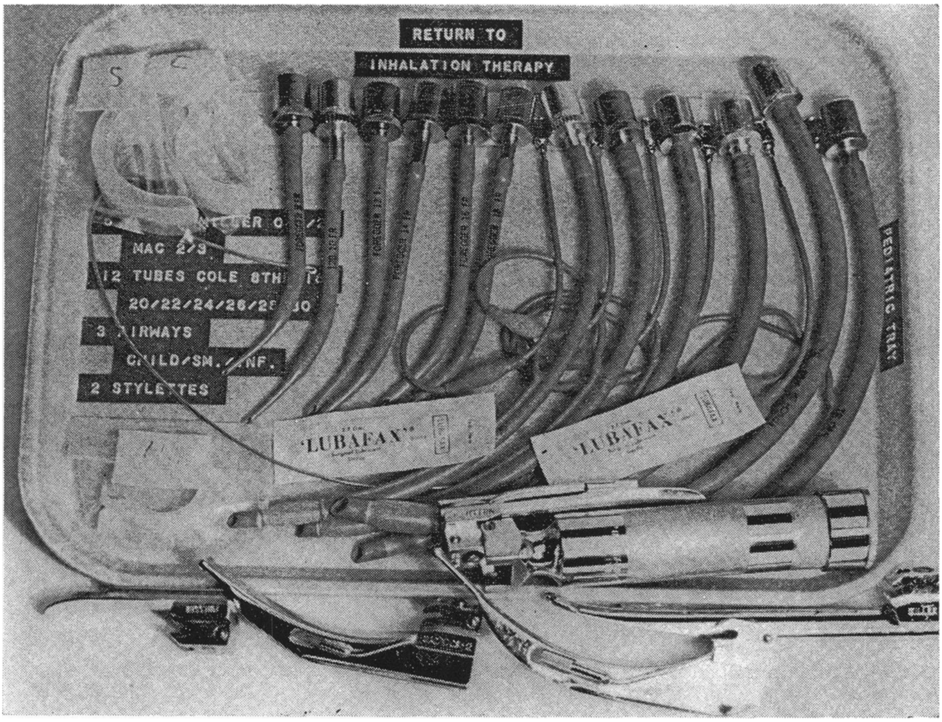

Fig. 6. Emergency pediatric intubation tray contains a set of Foregger "Cole"[5,6] infant endotracheal tubes (Fr. 20, 22, 24, 26, 28, and 30), each fitted with a 15 mm. endotracheal tube connector; six cuffed Rosch endotracheal tubes; Miller laryngoscope blades, No. 2 and No. 3; one batter-containing handle; two stylets of proper length to cover tube lengths; three oral airways for bite blocks; and a surgical lubricant to permit smooth insertion of the endotracheal tube into the larynx.

as soon as possible. If a second person is available, mouth-to-mouth ventilation should be instituted. Such a person may also check for peripheral pulses and advise the operator of his findings. If the operator is alone, he must continue the cardiac compression, ventilating the lungs every ten to fifteen seconds.

It is desirable to have a firm board available upon which to place the patient. Many hospitals are now equipped with these boards on each nursing unit, a practice that should be vigorously encouraged.

Several reports have appeared during the past few years concerning complications associated with institution of closed-chest massage. A high incidence of pulmonary bone marrow emboli was reported by Yanoff.[44] Silberberg and Rachmaninoff,[39] reporting autopsy findings on forty-six patients who had received external cardiac massage prior to death, listed fractures of the ribs, chest wall hematomas, rupture of the stomach, rupture of the quadrate lobe of the liver, and multiple gastric mucosal tears with hemorrhage, among their findings. It is evident that closed-chest massage carries the risk of morbidity and even mortality. These hazards can and should be minimized by practicing correct technique.

Closed-chest massage remains the

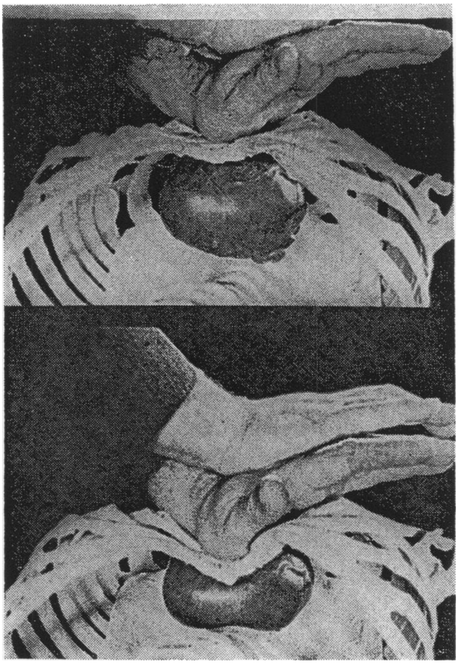

Fig. 7. Position of hands before and during external cardiac massage. (From Pulse of Life, Santa Monica, Calif., Pyramid Film Producers.)

first choice of therapy, having saved far more lives than have been lost through its use. There are some patients upon whom it is difficult to practice closed-chest massage with much hope of success. The barrel-chested, emphysematous, muscular ex-football player has even at the moment of death a seemingly incompressible chest that will not yield even to the most vigorous efforts. The elderly, osteoporotic, pigeon-breasted female may sustain a fractured rib or lacerated liver at the hands of a vigorous and excited potential saviour. For these patients and others suspected of having suffered cardiac tamponade or a massive pulmonary embolus, open-chest cardiac massage should be instituted with minimal delay, following provision of adequate ventilation with tracheal intubation. From a practical standpoint, this can be accomplished only in a hospital setting. Swan and Paton[41] have outlined preparations for cardiac arrest that occur both in and out of the hospital. Kattus and associates[25] have detailed the management of cardiac arrest in two patients in which external massage was employed for one and internal massage for the other.

Calling for help!

Although successful resuscitation has been accomplished by persons acting independently, chances for survival improve when more than one person is available to lend assistance. Cardiac emergency teams have been organized in several large community hospitals. The advantages of having a competent anesthetist, cardiologist, surgeon, and several nurses available are obvious. Unfortunately, such a group cannot frequently be amassed on short notice. Any help that can be provided by anyone in the immediate vicinity will usually prove valuable.

Monitor (the electrocardiograph)

In all but the most responsive cases of cardiac arrest, it is necessary to distinguish cardiac standstill from ventricular fibrillation; therefore, the electrocardiograph is used. Further, following an initial success at resuscitation, it is necessary to monitor cardiac activity for some hours thereafter. The electrocardiograph is an indispensable tool in assessing the patient's progress. One must be aware that the reward for successful resuscitation may be a second episode of cardiac arrest. The electrocardiographic tracing will frequently document failure in correcting the underlying cause responsible for the initial catastrophe.

Defibrillator (internal-external)

The treatment of ventricular fibrillation is accomplished in two stages. First, cardiac anoxia must be overcome by applying cardiac massage and ventilating the lungs. It is worth repeating at this point that an anoxic myocardium cannot be resuscitated and usually cannot be successfully defibrillated. Second, fibrillation must be converted to standstill by use of a defibrillator. There is no known pharmacologic agent that can be used as a substitute for electrical defibrillation.

The advantages of the direct current defibrillators over the alternating current models is now generally conceded. Newer models are supplied with large paddles for external use and smaller cup-shaped paddles for direct application to the surface of the heart.

Because of the high electrical resistance of dry skin, the use of electrode paste is necessary to increase conductivity. The resistance of skin is approximately 25,000 ohms, while that of the heart is 60 ohms. Greater than 1 ampere of current is required to defibrillate the average adult heart.

A brief discussion is in order concerning the assessment of adequacy of circulating blood volume. Cardiac massage, either direct or indirect, should produce a readily palpable carotid or femoral pulse. If a pulse cannot be detected despite apparently adequate massage, it must be concluded that a discrepancy exists between the circulating blood volume and the vascular space. It is a common experience for those having practiced open-chest massage to have squeezed the heart and noted that the heart was then slow in refilling. Two things immediately come to mind: increase the circulating blood volume and constrict the peripheral vascular bed. Any volume expander—dextrose, saline, dextran, or plasma—or preferably whole blood, will suffice during initial treatment, and one should not hesitate to use epinephrine to constrict the vascular bed despite the increase in myocardial irritability that it may produce.

Drug therapy for cardiac standstill consists of the following drugs: epinephrine, calcium ion, and sodium bicarbonate.

Epinephrine

The purpose of epinephrine, a most useful agent, has been discussed in the foregoing paragraph. An ampule containing 1 ml. (c.c.) of 1:1,000 epinephrine (that is, 1 mg.) is diluted to 10 ml. Two to 4 ml. of this solution (2:10 to 4:10 mg.) should be injected into the right or left ventricular chamber. With an intact chest, a spinal needle is inserted in the fourth intercostal space adjacent to the left border of the sternum. The possibility of injuring the anterior descending coronary artery or one of its branches exists, but is a relatively minor consideration under the circumstances. The injections may be repeated at frequent intervals.

Calcium ion

Calcium ion is usually administered in the form of 10% calcium gluconate. Again 5 to 10 ml. constitute the usual dose that may be repeated several times as necessary. It must be used with extreme caution in patients suspected of suffering from digitalis toxicity. There are otherwise no serious contraindications to its use.

Sodium bicarbonate

Inadequate perfusion of tissues is invariably associated with the development of acidosis due to the buildup of metabolic by-products incident to anabolic metabolism. Cardiac arrest, occurring for even brief periods of time, is invariably associated with profound acidosis. Myocardial tissue seems particularly vulnerable to this derangement of internal milieu. The immediate correction of this condition is, therefore, desirable and often essential in reestablishing effective spontaneous cardiac activity. As a rule of thumb, one can assume that the patient will require approximately 4mEq. of sodium bicarbonate solution per kilogram of body weight to correct the deficit. Sodium bicarbonate is available as a 7% solution supplied in 50 ml. ampules. This represents slightly more than 44mEq. per ampule. For rapid calculation, one can assume a concentration of 1 mEq. per milliliter without committing a serious error. The solution can be injected rapidly via an accessible vein. An initial amount equal to 2 mEq. per kilogram of body weight is given rapidly, followed by an additional 2 mEq. per kilogram administered slowly, beginning about ten minutes after administration of the initial dose.

Another solution that has proved successful on several occasions is 15 ml. of 7% sodium bicarbonate solution mixed with 2 to 3 ml. of 1:10,000 epinephrine solution. The total amount is then injected percutaneously directly into the right or left ventricular chamber, preferably the latter. This is followed by a short period of vigorous massage. The relatively high concentration of bicarbonate solution entering the coronary system produces a more profound and rapid elevation of pH of myocardial tissue than is accomplished by giving bicarbonate intravenously. It is well to recall that the sympathomimetic drugs (epinephrine) are far more effective within the range of normal pH values than in the presence of acidosis. Thus a secondary benefit is derived by correcting the alteration in acid-base balance.

Discussion

Whenever a physician is called upon to render aid to a patient in cardiac arrest, a dread arises in his mind concerning the ultimate outcome if his initial endeavors should prove successful. Assuming that the heart is started, has this unfortunate victim been anoxic for a long enough period of time to have sustained irreparable brain damage? To have reestablished circulation in a patient who has suffered severe permanent brain damage is indeed a tragedy. If the time interval between onset of arrest and initiation of treatment is known to be less than three minutes, the problem is virtually nonexistent. But how often can one be sure that he is starting treatment in time? A partial, although reasonably satisfactory, answer can be derived from the available statistics regarding the results of therapy practiced in many medical centers. In a report of 153 attempted resuscitations, performed by trained ambulance personnel, Wilder and co-workers[43] concluded that no fatal injuries were produced. None of the survivors was reported to have sustained significant brain damage. In a group of twenty infants and children reported by Greenberg,[21] however, three of the eight survivors sustained permanent central nervous system injury. Our own experience, supported by a perusal of available reports, has led us to conclude that the chances of obtaining a survivor with permanent brain damage are probably no greater than one in ten and, under most circumstances, probably less than one in twenty. Most patients who have sustained severe brain injuries have in all likelihood sustained sufficient myocardial damage to render attempts at resuscitation ineffectual.

In appraising chances for achieving success, a consulting physician should be obtained. The nature of the disease process that has resulted in cardiac arrest must be considered. This reversibility factor, or lethality factor, can usually be judged by asking a few pertinent questions of someone who knows the patient or has opportunity to glance briefly at the patient's record. Editorial comments have appeared in several journals that support the right of a patient suffering from an incurable illness to die in peace. The application of sound moral judgment, as well as good medical practice, is part of the consulting physician's responsibility.

Summary

Emergency resuscitation by the mouth-to-mouth method may be accomplished with careful attention to each of the following steps. First, tilt or extend the head back, clear the airway of the foreign material if it is obstructing the airway and ventilation, occlude the nose (or mouth), place the mouth of the rescuer over the mouth (or nose) of the victim, and blow air into the mouth (or nose) of the victim until the chest rises. It is important that all physicians and emergency personnel learn the technique of intubating the trachea. Adequate simple intubation and ventilation equipment must be available in the office, clinic, and hospital nursing stations, and paramedical personnel must be trained to use this equipment.

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